AEOLIAN ABRASION ON VENUS: PRELIMINARY RESULTS FROM THE VENUS SIMULATOR

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The *Venus Simulator* is designed for testing the mechanical effects of aeolian abrasion on rocks and particles at the surface of Venus. The Venus Simulator will impact sand or pebble-size particles with controlled velocity and controlled periodicity against a rock target in a carbon dioxide atmosphere at temperatures up to 770K and pressures up to 114 bar. These extreme conditions are achieved in the pressure vessel depicted in Fig. 1 which has an internal volume of 0.05 m^3. The vessel contains a 7 cm diameter, 75 cm long, tubular furnace which provides an electrically-heated gas reservoir. An abrasion device is inserted through the center of one of the end flanges into the reservoir and is viewed through a 5 cm thick quartz window. Illumination of the device is through a light pipe at the opposite end of the pressure vessel. A gas-pulsing system (Fig. 1a) produces rapid-cycle release of internal pressure and, in so doing, causes gas to be drawn from the reservoir through a 2 cm-long gas gun in the abrasion device. This flow projects particles at a rock target situated directly in the gas stream. Pressure in the vessel is maintained by a gas-intensifier system. The flowing gas is at the same temperature as the impactor and target.

The present test series is examining the role of atmospheric pressure on aeolian abrasion for a constant temperature of 737K. Results from a 20 bar/737K test are depicted in Figure 2. Both the rock target and the impactor were fine-grained basalt. The impactor was a 3 mm diameter angular particle chosen to represent a size of material that is entrainable by the dense venusian atmosphere and potentially abrasive by virtue of its mass. It was projected at the target 10^5 times at a velocity of 0.7 m/s (determined by high-speed video filming). The impactor showed a weight loss of ~1.2×10^{-9} gm per impact (calculated from the change in geometry) with the attrition (readily apparent from Fig. 2a & b) occurring only at the edges and corners. The arrow on one of the faces of the particle indicates a spot viewed in the SEM before and after impact and no damage had occurred. The impactor edges developed irregularly-defined surface layers of mechanically "bruised" material (Fig. 2c) and small impact pits with fracture patterns similar to those developed at room temperature. However, stylus profilometry and optical microscopy step-profiling suggested that the target had *gained* material, but further tests are required to substantiate this finding. The surface texture in Figure 2d certainly has the appearance of surface smearing of material, and there were no clearly-defined fracture patterns indicating chipping. Weighing the target before and after the test showed weight loss but was inconclusive because control samples of basalt subjected to the same conditions, except for impact, also lost weight.

It is concluded from these results that particles can incur abrasion at venusian temperatures even with very low impact velocities expected for Venus, but the impacted rocks may present some surprises.

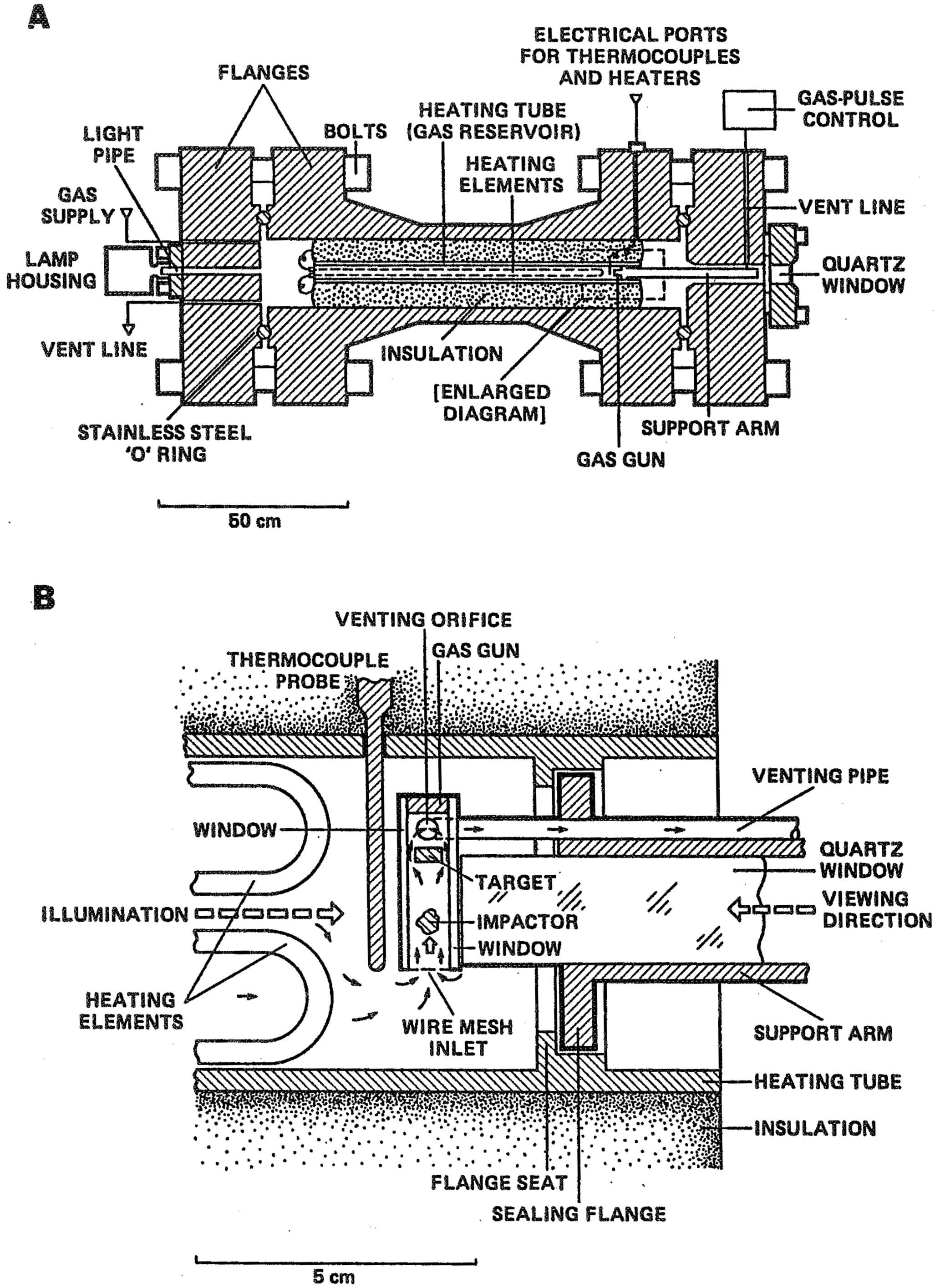

FIGURE 1. VENUS SIMULATOR
A. Pressure vessel sectional view showing internal heating arrangement and position of the gas-gun abrasion device.
B. Abrasion device sectional view (enlargement of area shown in A). Components enclosed by heavy outline form a single unit that is inserted into the pressure vessel through the right-side flange. The impactor rests on a wire mesh at the base of the gas gun until a momentary gas pulse projects it upward against the rock target. Gas flow is induced in the gun by exhausting gas through the venting pipe: gas flows from the reservoir through the mesh and past the target. After each venting pulse, the impactor falls back to the mesh.

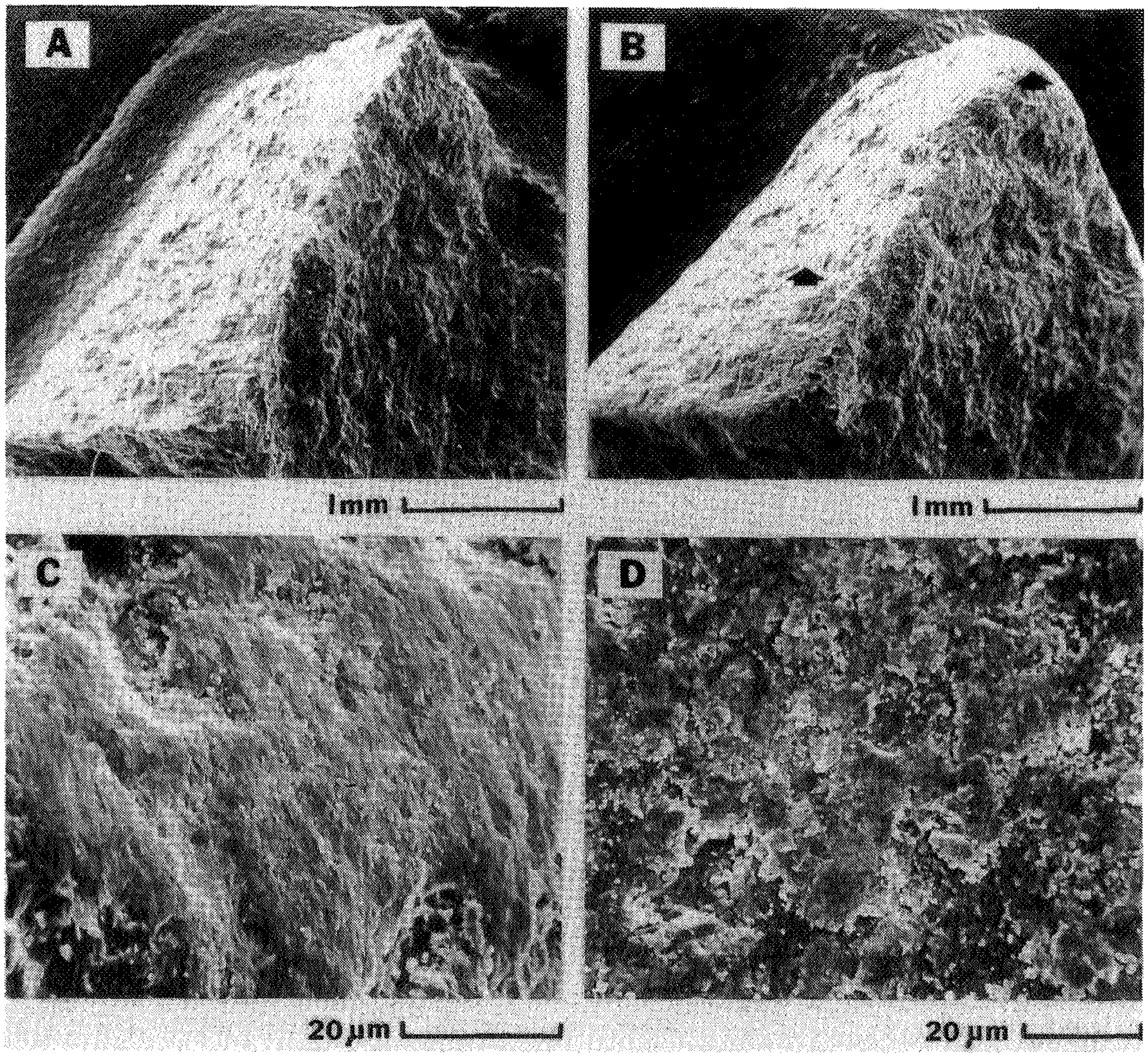

FIGURE 2. IMPACT TEXTURES ON TARGET AND IMPACTOR
A. Impacting particle before abrasion test: note sharp edges and rough fracture faces.
B. Impacting particle after abrasion test: attrition is very apparent -- corners and edges have been subdued. Arrow at top of particle indicates position of area shown in C. Arrow on left face of particle indicates position where impact damage is absent (see text).
C. Corner of impacted particle showing mechanical bruising texture (center of photo) and small impact pits (upper and lower left corners of photo).
D. Impacted target surface showing highly-irregular pattern of surface layer which may be mechanically-bruised target material, or smeared comminution debris transferred from the impactor.